INTERNATIONAL GEOPHYSICAL YEAR

UNIVERSITY OF MICHIGAN
JAN 9 - 1959
MAIN READING ROOM

HEARING

BEFORE

SUBCOMMITTEES OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE HOUSE OF REPRESENTATIVES

EIGHTY-FIFTH CONGRESS

SECOND SESSION

ON

UNITED STATES POSTINTERNATIONAL GEOPHYSICAL YEAR SCIENTIFIC PROGRAM

MARCH 26, 1958

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Wexler, Dr. Harry, Director, Office of Meteorological Research, Weather Bureau, member, National Academy of Sciences National Committee for IGY, and Vice Chairman, USNC Committee on Antarctica.

INTERNATIONAL GEOPHYSICAL YEAR

WEDNESDAY, MARCH 26, 1958

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON TRANSPORTATION AND COMMUNICATIONS,
AND SUBCOMMITTEE ON HEALTH AND SCIENCE, OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The subcommittee met, pursuant to notice, at 2:30 p. m., in room 1334, New House Office Building, Hon. Oren Harris, chairman of the committee, presiding.

Present: Representatives Harris (chairman), Friedel, Flynt, Jr., Macdonald, Wolverton, O'Hara, Hale, Bush, Derounian, and Younger.

Panel members: Dr. Laurence Gould, president, Carleton College, member, National Academy of Sciences National Committee for IGY; Chairman, USNC Committee on Antarctica. Dr. Harry Wexler, Director, Office of Meteorological Research, Weather Bureau; member, National Academy of Sciences National Committee for IGY; Vice Chairman, USNC Committee on Antarctica. Dr. Hugh Odishaw, Executive Director, National Academy of Sciences National Committee for IGY; Dr. Wallace Joyce, head, Office for IGY, National Science Foundation; member, National Academy of Sciences National Committee for IGY. Dr. S. D. Cornell, Executive Officer, National Academy of Sciences.

The CHAIRMAN. The committee will come to order.

The committee is very fortunate to have some very distinguished guests this afternoon. We do appreciate these outstanding educators and scientists giving us an opportunity for at least a brief visit this afternoon to discuss some rather important matters that we have been considering now for some time.

I might say as I again review the acquaintance with such outstanding men as Dr. Laurence Gould and Dr. Wexler, that we are reminded of a very pleasant experience we had when some of us had the unusual experience of going from the North Pole to the South Pole and spending a week in Antarctica and receiving the benefit of their advice and counsel during that time. Actually it has been my pleasure to have had the opportunity of saying "hello" to Dr. Gould since then but, Dr. Wexler, I have not been able to see you since that notable experience we had during last November.

We want to say that the committee extends a welcome to you and to all the others who are here this afternoon, Dr. Odishaw, Mr. Joyce, and Dr. Cornell, all of whom have been busily engaged in this scientific undertaking on a worldwide basis, using the world itself as a laboratory.

We welcome you to this committee this afternoon and certainly appreciate your taking a little time out of your busy schedule for this purpose.

Here comes the traveler that came very near breaking the record. As a matter of fact, Mr. Hale, of Maine, would have broken the record of the oldest man who ever traveled from one Pole to the other had it not been for a certain Englishman, I believe, who had beaten him to it.

Mr. HALE. Sir Hubert Wilkins.

The CHAIRMAN. Sir Hubert was with us while we were down there.

On January 13 of this year I wrote Dr. Bronk, President of the National Academy of Sciences, asking him to assist the committee in our legislative responsibilities by appointing a committee under the Academy: (1) To evaluate the United States participation in the International Geophysical Year program; (2) to assess the studies under the respective disciplines and the need for the continuation of the work already undertaken; and (3) outline the operation and the budget for the work deemed appropriate to be continued.

I might say, Dr. Gould, out of our experience in Antarctica during which Admiral Dufek told us of some of your problems and how necessary it was for a decision to be made and to be made then, that pursuing the suggestion he made, we did undertake to contact the appropriate source, and in this case it was the President of the United States, in which we proposed to him some of the same problems and questions, that appropriate action be taken to bring about some definitive decisions in order that they could know just what to expect.

We are very pleased with the fact that we did get immediate response and a decision was made.

Of course, you know what that decision is to arrange for a program to carry on this scientific work in the Antarctic beyond December 31 of this year.

Before we proceed further to get from you some of the suggestions we might have and some information regarding the program, I would like to recognize the presence here today of a gentleman whom I have known for some years and who is rendering an outstanding job as president of the University of Arkansas in my own State, Dr. Caldwell.

Dr. Caldwell, we are glad to have you come by and I do not know of a more appropriate time for you to visit this committee than now when we have these distinguished educators and scientists with us. We appreciate your being here. Of course, we know you have a busy schedule, too, and you can feel free to go on whenever you feel compelled to do so.

Now I suppose the better approach to this session this afternoon, Mr. Joyce, would probably be to conduct this in a sort of panel-like manner. As I understand, each of you have a particular phase of this program that you might like to explain.

I believe that Dr. Wexler and Dr. Gould have been at an international meeting at The Hague since the first of the year. Of course, we would be interested in knowing about the results of that meeting, too. So, with this brief explanation and word of sincere greetings to you here, we shall be glad to have you advise us of any information you have along the line I have suggested and the objective that we are seeking.

I suppose, Dr. Gould, we might let you start.

I think, if you will permit interruption, it will be helpful for the record to just note who is here and your particular position in connection with this scientific program.

Dr. GOULD. I am Director of the USIGY Antarctic program, Dr. Laurence Gould.

Next to me is Hugh Odishaw, who is Director of the whole Geophysical Year program for the United States.

Next to him, Dr. Harry Wexler, who is a member of the Subcommittee on Antarctica and is the Chief Scientist for the Antarctic program.

Next is S. D. Cornell, Executive Officer of the National Academy of Sciences and next to him Dr. Wallace Joyce of the National Science Foundation, who has taken care of the responsibilities of the IGY within the National Science Foundation.

The CHAIRMAN. Thank you very much. You may proceed now.

Dr. GOULD. With that identification I do like to record the appreciation of the Subcommittee on Antarctica for the report, Mr. Chairman, which your committee made about the International Geophysical Year after your journeys in the Arctic and the Antarctic. It is a document of which we are all proud and it is a document I use when the people write to me wanting to know about the IGY. I send them the one prepared under the aegis of your committee.

You have spoken in a friendly fashion about your journey to Antarctica. I had been there before but it was an education for me to go with you and your fellow Congressmen and to discover that congressional journeys are hard-working and productive efforts of considerable public import.

I was very much impressed with the penetrating questions that you and your fellow members asked and your desire to understand the scientific program, the difficulties and the ramifications of logistics support and all that is involved in the continuation of the kind of scientific program that has been carried out so successfully under the tripartite responsibilities of the Department of Defense through Task Force 43 of the Navy and the National Academy of Sciences and the National Science Foundation.

It is inevitable that, as we think of post-IGY activities, certain aspects would take precedence over others. This is particularly true of Antarctica.

In order to carry out a program in Antarctica, what we might call the lead time in making preparations is much greater than would be true anywhere else in the world and it was necessary to have decision regarding the continuity of the program in Antarctica earlier than elsewhere in the world.

From these remarks, it easily follows that we have proceeded further in planning for post-IGY activities in Antarctica than is probably true in IGY programs elsewhere.

I do not know how much time you have at your disposal or how detailed a report you would like me to give, Mr. Chairman. I have 21 typewritten pages here of absorbing, fascinating, interesting material. To me nothing is more interesting. I could read it to you or make some brief comments and solicit your questions.

The CHAIRMAN. If you like, Dr. Gould, to provide the committee with a copy for our use and information and then make some comments, it would probably be more advisable.

I am advised that we will probably have an interruption by rollcall before too long.

Dr. GOULD. Yes. I will then try in just a few words to outline what is contained in this complete report, something of the background of our thinking and our preparations for continuity in Antarctica.

The CHAIRMAN. Is that such that it can be made public and will it be agreeable with you to have it inserted in the record?

Dr. GOULD. Yes. Not only could it be made public but we are proud of it.

The CHAIRMAN. I am sure you must be.

Let it be included in the record and you may make whatever comments you desire.

(The report referred to follows:)

PRELIMINARY REPORT ON PROGRAM PLANS FOR ANTARCTICA, 1959

Dr. L. M. Gould, Chairman, Committee on Polar Research, National Academy of Sciences

1. SUMMARY OF INTERNATIONAL PLANS

Although a tremendous amount of new scientific observations have been obtained from the Antarctic atmosphere, ice, geomagnetism, aurora, ionosphere, cosmic rays phenomenon, the realization has grown that much still remains in this vast region of snow and ice. In realization of this the nations involved in Antarctic research at a recent meeting of the Special Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions (ICSU) convened to discuss further Antarctic scientific research. At this meeting 10 of the 12 countries announced their intention to continue with their scientific stations and even to expand, if possible, the present station network.

New Zealand will continue their full scientific program at the Scott station in the Ross Sea area as well as at a joint United States-New Zealand Hallett station.

France will continue the Dumont d'Urville station at Adelie Land.

Norway will continue its Maudheim station in Queen Maud Land.

The U. S. S. R. will continue their 5 IGY stations.

Australia, Japan, Argentina, and Chile have also announced their intention to continue their present stations.

Through SCAR the coordination of scientific programs and exchange of information will be carried out in the same manner as has been done during the IGY. The program has been broadened to include the fields of geology, vulcanology, cartography, biology, physiology, and increased emphasis will be given to a coordinated program in Antarctic oceanography. The decisions made by these many nations to continue with their Antarctic research arose not only from the magnitude of the task confronting them and a desire to fill in a vast geophysical unknown area, but also from a desire to reap the scientific benefits of the large initial investments which went into the establishment of these stations for the IGY.

2. INTERNATIONAL BACKGROUND

2.1 Comite Special de l'Annee Geophysique Internationale (CSAGI)

At the fourth meeting of the Comite Special de l'Annee Geophysique Internationale Antarctic Conference in Paris, June 13–15, 1957, the requirement for continued scientific research in the Antarctic, beyond the IGY, was reviewed and the following resolution was submitted to the International Council of Scientific Unions:

"Considerating the scientific importance of further observations in the Antarctic after the end of the IGY to best achieve the scientific investigations carried out on this occasion and to make use of the investments and observations made in the various stations.

"Recommends that the Bureau of CSAGI at its next meeting forward to the ICSU executive board the recommendation expressed as follows:

"That ICSU appoints a scientific committee to examine the merits of further investigations in the Antarctic, covering the entire field of science and to make proposals of ICSU on the best way to achieve such program. That in view of the desirability of avoiding an interruption in the current series of IGY investigations in Antarctica, ICSU takes immediate action in order that the findings be available by the middle of August."

As a result of this resolution the International Council of Scientific Unions appointed an ad hoc international committee to examine the merits of scientific investigations in the Antarctic, covering the entire field of science and to make proposals to the International Council of Scientific Unions on the best way to achieve such a program.

2.2 Ad Hoc International Council of Scientific Unions Committee

A meeting of the ad hoc International Committee was convened in Stockholm, September 9–11, 1957, and the following conclusion and recommendations were agreed upon:

"It was concluded, that there is need for further international organization of scientific activity in Antarctica.

"The committee recommended that ICSU establish a committee to undertake this task. Each nation actively involved in Antarctic research shall be asked to nominate one delegate each to such an Antarctic Committee; each delegate is authorized to have available, at any meeting of the Committee, advisers in various scientific disciplines, logistics, and communications.

"Finally, the Committee was of the opinion that the proposed continuation of scientific activity in Antarctic research should be regarded as inspired by the interest in Antarctic research arisen in connection with the International Geophysical Year, but it should be clearly understood that these proposals would not entail an extension of the International Geophysical Year. As a necessary background for the proposed continuation of scientific activity in Antarctica, each nation is urged to give its highest priority to the reduction, discussion, and publication of all observations made during the IGY."

3. SPECIAL COMMITTEE ON ANTARCTIC RESEARCH (SCAR)

3.1 Establishment of SCAR

As a result of the ad hoc Committee's recommendations, the ICSU established the Special Committee on Antarctic Research (SCAR). SCAR is a special committee of ICSU charged with furthering the coordination of scientific activity in the Antarctic, with a view to framing a scientific program of circupolar scope and significance. Dr. L. M. Gould was nominated by the United States National Academy of Sciences as the United States delegate to the SCAR Committee. In establishing its program SCAR will take care to acknowledge the autonomy of other existing international bodies.

List of officers and members: President: Ing. Gen. G. Laclavere, IUGG (France); vice president: Prof. K. E. Bullen, Australia; secretary: Dr. V. Schytt, IGU (Sweden); finance committee: Dr. L. M. Gould (U. S. A.) and Dr. M. M. Somov (U. S. S. R.); IUBS: Dr. A. Bruun (Denmark); Argentina: Capt. L. de la Canal; Belgium: Prof. J. van Mieghem; England: Dr. G. de Q. Robin; France: Mr. B. Imbert; Japan: Prof. T. Nagata; New Zealand: Dr. E. I. Robertson; Norway: Prof. L. Harang; South Africa: Mr. J. J. Taljaard; Chile: No permanent delegate nominated.

3.2 Decisions of SCAR

The following decisions were made:

It was decided that research programs formulated by the first meeting of SCAR shall be circulated to countries and international scientific unions participating in SCAR. Comments shall be invited on these programs, and on receipt of the replies, they shall be incorporated into the program before the final program is circulated.

The resolutions and research programs adopted by SCAR shall be submitted to other countries not belonging to SCAR, to encourage their participation in new programs or in the maintenance of the Antarctic stations which might otherwise be abandoned.

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Suitable relations with SCOR and other international scientific bodies interested in Antarctic research shall be established, for the interchange of information and coordination of programs.

ICSU shall be requested to inform the United Nations through the proper channels of the existence and purpose of SCAR.

It is agreed that cooperative programs by several nations be encouraged to enable maintenance of the present Antarctic station network and possibly an increased network.

The SCAR wishes that the exchange of observations and information resulting from Antarctic research shall continue in the excellent manner which has prevailed during the IGY.

For the purposes of SCAR, it was agreed that the "Antarctic" shall be bounded approximately by the Antarctic convergence.

The meeting expressed its gratitude to the administrative secretary of ICSU and his staff for the very valuable help they have given during the meeting, and acknowledges the financial assistance offered by ICSU to initiate the work of SCAR.

3.2.1. Report of SCAR Working Group I: Meteorology, oceanography, cosmical physics, biology, physiology

(a) Regular observations

Meteorology.—Surface and upper air synoptic observations and radiation measurements. These observations are necessary for weather and climate studies. The climate of Antarctica being very variable and changing very rapidly in the season and from season to season, a period of 10 years' continued observations is a minimum requirement.

Oceanography.—All the Antarctic expeditionary ships should endeavor to implement the program suggested by SCOR, in particular synoptic observations of temperature, salinity, and oxygen across the convergence zone in order to collect data along the meridians. 8–15-day periods for such simultaneous observations should be established through international agreement.

Investigations should be carried out on the coastal shelf as well as in deeper water.

Remark.—Working Group I stresses to Working Group II the importance of marine cartography of the coast and the topography of the bottom near the continent.

Ionospheric physics.—Vertical ionospheric soundings according to the IGY program should be continued on a routine basis at a limited number of stations. These stations will form a part of the permanent network of ionospheric stations and they ought therefore to be continued for a number of years (a sunspot period).

Auroral physics.—Auroral all-sky camera recordings should be continued for some years at one station very close to the auroral zone and at a second station some distance from the auroral zone.

Geomagnetism.—Normal and rapid recording of the three components D H Z of the magnetic field should be continued at one station at least for a number of years covering a sunspot period.

Biology and physiology.—For terrestrial biology, it is important to study as many animals as possible. For marine biology, the SCOR program should be implemented.

(b) Special observations

Meteorology.—Measurements of the total content of ozone by means of spectrophotometer should be continued for a number of years at a selection of stations. The distribution of the vertical distribution of ozone should also be determined with ozone sondes.

Traverse party should take the temperature of the ice down to at least 10 meters as the temperature at 10 meters is very similar to the mean annual temperature at the surface.

Measurements of carbon dioxide content of the air should be carried out as during the IGY.

Ionospheric physics.—Measurements of radio noise and direction of atmospherics should be continued as well as the observation of whistler in collaboration with Arctic observations.

Auroral physics.—Special studies on auroral heights, direction of forms, etc., based on parallactic photos of aurorae. Moreover, spectral observations should be taken as well as radar reflections from aurorae.

Geomagnetism.—The group stresses the importance of a geomagnetic survey of the permanent field in the Antarctic area (continent and southern seas).

Cosmic rays.—Work in cosmic rays and other specialized fields for which the Antarctic offers opportunities for throwing light on basic problems should be encouraged.

Atmospheric nuclear.—Radiation stations engaged in measuring the radioactivity of air and precipitation should carry that work on as far as possible after the IGY. Other stations are invited to initiate such a program.

Rockets.—Rocket sounding program should be enlarged to cover the winter season, measuring temperatures and winds up to 80 kilometers at the rate of one per week.

(*c*) *Networks*

Considering the subject from a scientific viewpoint, the working group arrived at the following recommendations:

Meteorology.—The Working Group I recommends that the countries participating in Antarctic research establish nationally, or through collaboration between two or more countries, the meteorological network necessary for the implementation of the synoptic program.

On the coast.—In addition to the 14 IGY coastal stations, 7 stations located in the following regions:

1. One station between Hallett and Dumont d'Urville.
2. One station between Dumont d'Urville and Wilkes.
3. East of the Weddell Sea (if Halley Bay is abandoned).
4. Southwest of the Weddell Sea.
5. Three stations between the Palmer Peninsula and the Ross Sea.

Island stations.—Particularly Peter the First Island, Bouvet, Heard, etc.

In the interior.—In addition to the 8 inland stations (including Sovietskaya), 5 stations located in the following regions:

Longitude	*Latitude*
0°	80° S.
30° E.	75° S.
60° E.	75° S.
130° E.	75° S.
80° W.	80° S.

The working group urges the participating countries to increase the number of ozone stations.

Oceanography.—All expeditionary ships should participate in the oceanographic program.

The importance of winter observations should be stressed.

Cosmical physics.—The minimum network requirements for ionospheric and auroral physics and for geomagnetism are mentioned in paragraph 1. However, all stations presently equipped and which plan to continue their operations after the IGY should be invited to make full use, as far as possible, of their established equipment.

Weather central in the Antarctic.—A weather central for Antarctica should be maintained in the Southern Hemisphere. The problem of the location should be studied by the interested countries.

3.2.2 Report of SCAR Working Group II: Geology, glaciology, morphology, cartography

(*a*) Geology should be part of all permanent programs. In addition to the classical studies in structure, stratigraphy, and related fields, special attention should be directed to—

1. The terrain beneath the ice as revealed by seismic studies.
2. Postglacial and/or quaternary geology at coastal stations.
3. Paleoclimatic studies.
4. Paleomagnetic studies.
5. Submarine geology.

(*b*) Glaciological studies should include—

1. Thickness, structure, and volume of inland ice as revealed in seismic findings. Such seismic sounding should be made so as to reveal the maximum amount of information about the bedrock beneath the ice.
2. Regime observations at all stations.
3. Annual stratification of firn to establish climatological significant precipitation records.

4. Structure of the inland ice sheet and ice shelves as revealed from deep pits and bore holes.

(*c*) *Geomorphology.*—Studies of land forms should be made with particular attention to the geological role of an inland ice sheet past and present.

(*d*) *Cartography.*—A comprehensive, coordinated mapping program should have high priority. Adequate maps and charts are necessary tools for the support of most of the proposed Antarctic program. Aerial photographs are likewise very desirable tools and should be secured whenever feasible.

3.2.3 Report of SCAR Working Group III: Seismology, gravity, and vulcanology

Seismology is to a very large extent concerned with using records of earthquake waves to infer the earth's crustal and subcrustal structure. There are two principal problems of Antarctic seismological research:

(*a*) To use local earthquakes to infer Antarctic crustal structure; (*b*) to use distant earthquakes both to obtain evidence on Antarctic structure and also on the earth's deeper structure. In connection with (*b*), a further point is that the establishment of first-class seismological observatories in the Antarctic can fill in an important global gap; it is important for the advance of knowledge of the earth's internal structure that the global coverage of seismological observatories should be as uniformly distributed as possible.

The setting up of new seismological observatories in the Antarctic is to a considerable extent experimental. Relevant factors include the suitability of particular sites (difficulties with microseisms, etc.), the human difficulties, and the as yet not fully known local seismicity. There must of necessity be much trial and error, moving gradually toward the establishment of a number of first-class observatories. The present number of seismological observatories in the world is of the order of 700. There should ultimately be not less than a corresponding number, determined on the basis of geographical area, of stations in the Antarctic. A priori, it is desirable that the stations should be uniformly distributed over the area; but special problems, and special features of local seismic activity, may in due course lead to a deviation from this.

It is desirable that each station, in addition to having an adequate set of good seismographs, should have assured absolute time marks recorded on the seismogram, so that absolute time can be read to less than a second. It is desirable that stations should in due course become permanent; in seismology it is in general important that long-sustained data from fixed centers should be obtained. It would be unwise to plan a detailed program now for the year after 1958. It is unwise to plan a detailed program now for the year after 1958. It is most important that, first of all, very considerable attention be paid to collating the results obtained during the IGY period. But it would be a pity if well setup stations were to be abandoned.

Broadly speaking the problem of gravity is similar to that of seismology, in that the Antarctic constitutes a serious gap in global coverage which it is most desirable to fill in. Gravity observations to throw light not only on aspects of local crustal coverage is desirable, but subject again to more intensive coverage where there are special problems.

It is desirable to have absolute measurements of gravity at certain stations, and the means of making comparative measurements elsewhere which can be linked with the base stations. The ultimate aim should be to achieve a coverage comparable with that in other continental areas.

It is more difficult to set down a specific program for volcanology. To begin with, vulcanological studies are likely to emerge from broader geological studies, and then become more specialized as development continues.

The Antarctic borders on the Pacific Ocean, round the rim of which is much of the world's principal seismic and volcanic activity. Eighty-five percent of the total energy released in earthquakes comes from the Pacific Ocean rim. It is therefore important that great attention be paid to the seismic and vulcanological problems of the Antarctic.

4. DESCRIPTION OF PROPOSED UNITED STATES SCIENTIFIC PROGRAM (1959)

4.1 General description

Even though the research program conducted in Antarctica during the IGY will achieve the greatest increase in knowledge ever attained from this area, and a great quantity of data will have been gathered, Antarctica still remains largely unexplored. Encompassing almost 6 million square miles, this continent, covered by a mantle of snow and ice averaging some 10,000 feet in thickness, still

poses many problems in the physical and biological sciences. Its unique qualities as the greatest repository of cold are critical in world weather. The melting of its snow and ice plays an important role in oceanic currents. The presence of the South Magnetic Pole makes it an unusually important region in which to study cosmic rays and a unique region in which to study the aurora australis. The fact that Antarctica is a continent and thus provides a stable platform allows the study of ionospheric phenomena during the absence of sunlight and also provides an excellent platform for scientific observation stations. Study of its geological and glaciological features have barely begun. In short, Antarctica remains a region affording exceptional opportunities for scientific research.

There is worldwide recognition that the observations and measurements made during the IGY will not only greatly increase our understanding of that region, but afford a remarkable opportunity for continued and augmented scientific work. Such work will not only yield new knowledge but will simultaneously enhance the value of IGY data, and the latter data in turn will enhance the value of future findings. For such reasons as these the nations active in the Antarctic and possibly additional countries have planned to continue research in the Antarctic after the IGY.

This proposed research program for the United States is based on the assumption that an adequate and effective program will be carried out and will be well coordinated with the stations to be maintained by other countries. By means of such a many-nationed integrated program, the efforts of each nation will be enhanced because of the sharing and interchange of data. The Special Committee on Antarctic Research (SCAR) has studied these matters and has made certain recommendations which are reflected in the scientific program presented in this document. Ten nations have announced their intention to continue scientific research in the Antarctic and SCAR will invite other nations to participate in additional new stations. The United States program is based on research at 5 stations and cooperative programs with other countries at an additional 4 stations. The United States program not only includes studies in the geophysical sciences, but also within the context of the SCAR recommendations, includes programs in geology, volcanology, and the biological and medical sciences.

Some of the most important considerations that call for significant participation of United States scientists in Antarctic research are the following:

(1) Properly and effectively to conduct programs in geophysics, the relationships of many fields being worldwide and even interplanetary in nature, broad national and geographic participation is necessary, with emphasis on research in those areas (particularly the polar) where relatively little has been done in man's history.

(2) An international, coordinated program will add greatly to the value of all elements of an Antarctic research program and will vastly enhance the effort of the United States, particularly through the interchange of data.

(3) Significant new basic, scientific knowledge will be obtained, much of it also of great practical value (e. g., in meteorology and radio physics).

(4) The conduct of Antarctic research has many byproducts. For example, there is a continuing need within the United States to develop personnel competent for polar research and other polar activities, especially as so much of the earth's surface (the Antarctic, the Arctic Ocean Basin, and Greenland) are covered with ice. There is also, broadly speaking, an educational value as by it very nature polar research is interest-provoking and appeals to the youth of the Nation. The stimulus by such activities during the IGY has been appreciable.

4.2 Program by field or activity

Aurora.—The present programs of visual and other programs at Byrd, Pole, Wilkes, Hallett, and Ellsworth Stations will be maintained with one auroral physicist at all stations except Hallett, where a New Zealand scientist would be stationed. Auroral equipment from Little America, including the all-sky camera, the scanning spectrometer, and visual auroral and meteor observation materials, would be moved to the new station to be established at Beardmore and one additional scientist would be required at this station. One scientist would be assigned to the auroral program to be maintained at Scott Station jointly with New Zealand.

Biological and medical sciences.—The established stations in the Antarctic offer a unique opportunity for the conduct of scientific research in these fields. A laboratory facility with standard equipment for scientists in the biological and

medical fields is to be established at the Naval Air Facility, McMurdo. During the 1959 winter period, programs in physiology, marine biology, and bacteriology will be conducted at this biomedical facility. A physiologist will investigate the effects of cold plus altitude at the South Pole Station. A program in physiological psychology at Hallett Station will investigate sleep patterns of personel during the winter and summer months.

Scientists will carry out summer science research programs in zoology, biology, psychology, and lichenology. These scientists will utilize the McMurdo biomedical facility while collecting data in the McMurdo area.

Cosmic rays.—The present programs at Wilkes and Ellsworth Stations would be maintained under cooperative arrangements with other countries. In addition, small balloons carrying miniaturized Geiger counters and radiation detectors would be launched for the study of cosmic ray intensity and energy spectrum.

Geomagnetism.—The geomagnetic program at Byrd Station would be maintained. The program presently at Little America would be transferred to the new Beardmore Station. Cooperative programs would be maintained at Wilkes, Hallett, and Scott stations, although no United States personnel will be required.

Glaciology, geology, traverse seismology and gravity, volcanology, glacial geology, micrometeorology.—These programs are grouped together for greater ease in planning and administering field operations. Winter and summer programs will be conducted as during the IGY.

A primary traverse is planned for the Byrd Station with smaller efforts for the South Pole, Beardmore, and Wilkes Stations. Summer field programs from Beardmore and Wilkes will also include work in geology and glacial geology. A glaciologist will be stationed at Ellsworth and two glacial geologists at Hallett and Scott Stations on a cooperative basis with other counties. The summer program at the McMurdo air facility and its vicinity will include work in glacial geology, geology, geomorphology, volcanology, ice-shelf deformation studies and elements of a deep drilling program. Ice samples will be collected for the analysis of oxygen isotope ratios. A small administrative office will be maintained to carry out the necessary equipment procurement and planning and coordination of the field program.

Ionospheric physics.—The IGY ionospheric program would be maintained at Byrd, Pole, Hallett, Wilkes, and Ellsworth Stations. Programs at Hallett, Wilkes, and Ellsworth as well as Scott Base would be conducted jointly with the other countries concerned. A program would be established at Beardmore Station with the equipment presently at Little America. One scientist would be provided at all stations except Byrd, where a second scientist would be provided for the radio noise program.

Meteorology.—The IGY program will be maintained at all stations. The station breakdown is as follows:

Beardmore Station.—Complete surface and upper air, plus special scientific meteorological observations as at Little America during IGY.

Amundsen-Scott Station.—Similar to IGY program plus complete ozone program.

Byrd Station.—Similar to IGY program.

Little America Station.—Basic surface and upper air observations.

McMurdo Station.—Scientific meteorological observations and liaison. (United States Navy expected to provide basic surface and upper air observations.)

Hallett Station.—Scientific meteorological observations. (U. S. Navy expected to provide basic surface and upper air observations.)

Wilkes Station.—Similar to IGY (possible joint United States-Australian operation).

Ellsworth Station.—Similar to IGY (possible joint United States-Argentine operation).

Oceanography.—Three teams of two oceanographers would conduct programs in oceanography and marine biology on shipboard. The observations would be made in Antarctic waters on board Navy ships during the summer operational season. Standard oceanographic stations consisting of biological samplings, Nansen casts, bottom sampling, and bathythermographs will be made, and it is hoped that seismic refraction profiles, using two ships, could be made.

Rocket soundings of the atmosphere.—A rocket research program consisting primarily of a shipboard launching program, together with a small land-based effort is planned. Several types of small rockets will be used in the program.

The shipboard program will be conducted during the 1959–60 Antarctic summer season, and the small land-based party will begin launchings during early 1960. Shipboard experiments will include studies of atmospheric density (falling sphere method), cosmic rays (utilization of Geiger counters, proportional counters, ionization chambers, and scintillation counters or Cerenkov detectors), ion and electron density (bipolar probe technique), radiowave absorption, ionospheric winds, auroral particles and ultraviolet Lyman-alpha radiation and X-rays from the sun during solar flares. During the winter period rockets will be launched to observe the intensity of cosmic rays at the Antarctic.

Seismology (station).—The net of station seismographs presently installed at the Byrd, South Pole, Wilkes, and Hallett Stations will be maintained, the latter two in cooperation with Australia and New Zealand, respectively. Personnel engaged in other programs are expected to maintain and operate the equipment.

4.3 Program by stations

Amundsen-Scott South Pole Station.—This station offers a unique opportunity for research in glacial conditions and snow accumulation, studies of the effects on ionospheric properties of the absence of the sun during the protracted winter season, and the auroral phenomenon within the maximum auroral zone.

The current IGY research program would be maintained including the program in micrometeorology. A limited summer traverse program would be conducted with observations in glaciology, seismology, gravity, and glacial geology. An additional ozone program would also be instituted.

Byrd Station.—Location of this station in the interior of Marie Byrd Land facilitates the conduct of a broad summer oversnow traverse program as well as a very important program in meteorology. This station is situated well within the maximum auroral zone, thus adding to the importance of auroral and ionospheric observations. Traverses from this station will study the region due north, which lies adjacent to an unexplored coastline, and also due south, in a region approaching the South Pole.

Beardmore Station.—The disestablishment of Little America will create a major gap in the United States Antarctic scientific program. As it is expected that the Beardmore auxiliary air operating facility would be maintained by the United States Navy, it is planned that this facility be expanded.

The establishment of the Beardmore Station will allow the movement of the majority of the IGY scientific equipment presently located at Little America Station. The scientific program would approximate that of Byrd Station and would include studies in aurora, ionospheric physics, geomagnetism, meteorology, and glaciology. A summer program would take advantage of the proximity of this location to the nearby mountain ranges for geological and glacial geology studies, as well as for a limited traverse program on the Ross ice shelf, which would include a program in glaciology, gravity, and seismology.

Kiel Field (Little America).—It is planned to continue a year-round meteorological station at this location, with modifications made to the existing air operation facilities, to accommodate this facility.

Hallett Station.—The existing scientific program at this station, including studies in aurora, ionospheric physics, meteorology, seismology, and geomagnetism, would be continued on a cooperative basis with New Zealand. It is noted that the bulk of the meteorological program is carried out by United States Navy aerographers, and it is planned to continue this type of operation, which also includes one civilian meteorologist. The program would be augmented by the addition of a program in physiological psychology.

Naval Air Facility, McMurdo—Scott Base (New Zealand).—Planning is based on the continued maintenance of the air facility at McMurdo by the United States Navy. It is highly desirable that a full-scale scientific program, which is presently being conducted at Scott, be continued. It is planned to continue such a program cooperatively with New Zealand at Scott Base, with the United States providing personnel for the programs in aurora, ionospheric physics, and glacial geology. A small wintering land-based rocket program would be established at McMurdo. The current program in meteorology, which is being conducted by the United States Navy, would be continued, with the augmentation of one civilian meteorologist.

Wilkes and Ellsworth Stations.—Except for a reduced program in glaciology, it is planned to provide scientists to maintain these stations on a cooperative basis with other countries. These plans depend upon entering into discussions and agreements with appropriate committees in other countries, and these dis-

cussions shall be initiated soon. In the event that joint operation efforts are not possible, serious consideration should be given to provision of United States logistic support, for these stations are important and should not be abandoned.

Dr. GOULD. Mr. Chairman, I will make then just a very few brief comments about it.

You remember that the whole International Geophysical Year is under the aegis of the International Council of Scientific Unions. This ICSU, as we call it, appointed a special committee to implement the International Geophysical Year, and way back in June of 1957 this special committee for the IGY began thinking of what would happen when the IGY was over.

At a meeting in Paris they passed resolutions pointing out that the continuity of observations in Antarctica were of peculiar importance and we ought then to begin taking thought of what should be done.

Accordingly, recommendations were made to the parent organization, ICSU, that an ad hoc committee should be appointed to discuss the problems involved in continuing the Antarctic program. This ad hoc committee was convened in Stockholm September 9 to 11, 1957, and the committee recommended that the International Council of Scientific Unions, which is the permanent, continuing body of international scientific cooperation, take steps to establish a committee for the continuation of the scientific program in Antarctica. Accordingly, the International Council of Scientific Unions established a special committee called A Special Committee on Antarctic Research, and the various countries operating in Antarctica now were to designate, through their adhering bodies, delegates who were to meet at The Hague from the 3d to the 6th of February 1958.

We did meet at The Hague. The National Academy of Sciences designated me as the representative for the United States. We had a very successful 3-day meeting, and the countries which have participated in IGY have signified their desire to continue in this cooperative enterprise essentially along the lines that have worked out so well with IGY.

Now, when we began thinking about the kind of scientific program we should have after IGY, our vision, of course, became larger than had been true of IGY. You may remember that IGY is global in its scope and that all of the disciplines involved in it, by the nature of the case, have global relevance. For instance, we studied meteorology, we studied aurora and air glow, geomagnetism, and many other things. It means whatever information we get about any one of these disciplines in Antarctica has relevance anywhere else in the world.

There are a lot of geophysical sciences and there are a number of other related scientific areas which need further examination in Antarctica. So, as we contemplate a program for continuity, it is an expanded one over IGY.

I am sure, Mr. Chairman, you will understand that I have a very personal point of view in this. I am a geologist. Geology was not included in the IGY program because the geology of any particular local area has no time relevance to the geology on the other side of the world. But as we look forward to the future, certainly geology must be a part of the program, and certainly as we are able we must have a program in surveying and mapping. Charts and maps are indispensable tools for almost all of the other sciences.

Our program, then, contemplates the continuity of the basic programs in meteorology and oceanography, aurora and air glow, geomagnetism, ionospheric physics, seismology, glaciology, plus the ones I have just indicated, geology, geomorphology, and cartography.

That, then, Mr. Chairman, is a very hasty outline of the scientific program on which all of the participating nations agreed at our meeting in The Hague.

If I interpret that buzzer correctly, this is a good time for me to have to come to the end of my introduction or summary, Mr. Chairman.

The CHAIRMAN. Dr. Gould, I wonder if it would be too much of an imposition on you and Dr. Odishaw and Dr. Cornell and Mr. Wexler if we may go answer the rollcall and come back?

Dr. GOULD. No; we will wait for you.

The CHAIRMAN. It will only take a few minutes to do that.

If you will permit and you can wait for us, we certainly will appreciate it.

I understand you are not going to be available for some time after today.

Dr. GOULD. I will be back home. So I will be very glad to wait.

Mr. YOUNGER. If there are going to be a lot of amendments, a lot of important votes over there on this bill from now on, I would like very much to be recorded over there on these amendments that are up. The general debate is over and they are reading the bill for amendments. I question whether we should sit.

The CHAIRMAN. The point is that we have to decide what we are going to do.

Mr. YOUNGER. I cannot come back. I would like to hear them but I think, as far as my duty is concerned, it is over there on these two amendments which to us are very important.

The CHAIRMAN. Are you having a meeting here next week?

Dr. GOULD. I am not but there may be others about which I do not know, Mr. Harris.

(Discussion off the record.)

(Whereupon, the subcommittee recessed, to reconvene in room G–12, the Capitol.)

The CHAIRMAN. Dr. Gould, I think we did perhaps interrupt you before you concluded. It will not be necessary for you to go back over it now under the circumstances, but is there anything further you would like to say?

Dr. GOULD. I want to make 1 or 2 comments to make sure for the record I did give a complete listing of the various fields of scientific activity which we wish to explore.

I am not sure I included biology and medical science. To be sure we have done a bit in these areas as a sideline with IGY but when we think of a continuing scientific program these should be included on a broader basis.

With that comment, I think that is enough for the present, Mr. Chairman, about the scientific program as a whole.

Before we move to anything else, I would like to ask Mr. Odishaw, the executive officer of IGY, to tell you some extraordinarily interesting satellite news that just this moment came.

Dr. ODISHAW. I have been in touch with my office and the third United States satellite is in orbit. It was launched by Army, a modified Jupiter-C vehicle, launched at 12:38. Its period of revolution appears to be about 120 minutes. It looks as though the perigee distance or the distance nearest earth is rather small. Perhaps these are premature figures. Perhaps 120 miles. The apogee distance, farthest point from the earth may well be perhaps 2,000 miles.

These figures are extremely tentative and are not based on any final computations. This work is still going on.

Now, in all probability this satellite will not have a long life. It is apt to be a short life, perhaps a few weeks, but even here my information is extremely tentative.

From the point of view of the scientific experiments aboard this satellite it is a very satisfactory orbit. As a matter of fact, the range from 100 miles out to 2,000 miles will be very useful in studies of cosmic rays and the principal experiment aboard is the cosmic rays experiment.

The CHAIRMAN. Thank you very much, Doctor.

Mr. HALE. That is a very curious orbit, such an apogee and a long perigee or the other way around.

The CHAIRMAN. The closest was 120 miles and the farthest distance was what?

Dr. ODISHAW. Two thousand. These are very rough estimates.

I think you should wait until there are official reports from the computations that are now going on before taking my tentative remarks as the real facts of the situation, but this is how the picture looks now.

The CHAIRMAN. That is very interesting news indeed. Is it a small satellite?

Dr. ODISHAW. It is similar in size and weight to 1957 Alpha, which was the first satellite launched by the Jupiter-C. It has the same configuration basically in size and weight. As I recall, the weight is about 18½ pounds.

Mr. O'HARA. What is its speed, Doctor? Do they know?

Dr. ODISHAW. I cannot give you a figure on that. My estimate would be that it is between 18,000 and 19,000 miles per hour.

Mr. O'HARA. It should be visible then to the ordinary man down here.

Dr. ODISHAW. Yes. We expect it will be visible as the first Explorer satellite. The problem, of course, is the problem of its latitude range. Washington is considerably above its maximum excursion above the equator.

The CHAIRMAN. Thank you very much, Dr. Gould.

I am sure you have observed the fact that we have recruited some of those who were with us on the trip, Mr. Macdonald over here, Mr. Flynt, and Mr. Derounian. We are glad that they could join us here for the rest of this meeting.

Now, do you have anything further than you wished to say?

Dr. GOULD. I think not unless you wish to ask specific questions.

The CHAIRMAN. Dr. Odishaw, did you have anything further you wished to comment on about the program at this time?

Dr. ODISHAW. I do not think so, certainly not in the Antarctic area. I feel Dr. Gould and Dr. Wexler both are extremely and intimately familiar with it.

The CHAIRMAN. Dr. Wexler, we will give you a chance to give us a little more factual information about the weather.

Dr. WEXLER. We have had our share of Antarctic weather here. As a matter of fact, that storm we had in mid-February was as severe as any Antarctic storm I have seen. Of course, I have been there only in the summer, so I have no basis for comparison. I thought perhaps you might like to hear a little bit more about the Hague meeting.

I think my notes to Dr. Gould have been distributed but I thought perhaps a brief review might be in order, Mr. Chairman.

The CHAIRMAN. Yes, we were going to ask about it anyway.

Dr. WEXLER. Yes, sir.

The countries represented there indicated with 1 or 2 exceptions that they would continue their stations after 1958. One of the countries which was uncertain at the beginning, France, at the very end of the meeting said definitely they would continue their station.

Norway indicated some uncertainty but they seemed rather confident that with the assistance perhaps of Sweden and Denmark, they would continue their stations.

The United Kingdom was still uncertain at the end of the meeting as to whether they would continue their station at Halley Bay.

The Soviet Union indicated they would continue their stations.

Mr. HALE. All of them?

Dr. WEXLER. All of their stations.

At that time they had not reached their final station which was the station at the pole of inaccessibility. They said they would continue to drive as much as they could toward that station and wherever they stopped that would be it. They have since stopped at a point deep in the interior, not at the point they hoped to get to but some intermediate point, which is perhaps 13,000 feet high.

We discussed the various scientific subjects and Dr. Gould mentioned earlier the disciplines have been expanded because they are confined to the Antarctica and as such they can deal with subjects related to the Antarctica more than with respect to the earth as a whole.

It is interesting to note that the Soviet representative, Dr. Somov, who is a well known Arctic scientist, and who spent a year at the Antarctic station, said from the meteorological point of view the network of stations is not adequate.

He proposed setting up another dozen stations. Seven on the coast; 3 between Little America and the foot of the Palmer Peninsula. These would be coastal stations in a portion of Antarctica which has never been penetrated to the coast. Ice conditions are very bad.

Dr. Somov went on to suggest a station for the southwest corner of Weddell Sea, which our expedition last year tried to get to but failed to set up a camp because of unsuitable ice conditions. They went back and set up the Ellsworth Station.

He went on to suggest that if the United Kingdom gave up its Halley Bay Station, called the Royal Society Station, then that should be reoccupied by another nation.

He went on to suggest another station between the United States Wilkes Station on the Knox coast and the French station and another station between Dumont d'Urville and Hallett.

Mr. MACDONALD. That is the Bellinghausen Sea area.

Dr. WEXLER. Yes.

Mr. MACDONALD. Will they put those stations in by ship or overland?

Dr. WEXLER. They did not talk about anyone putting them in, Mr. Macdonald. These were just designated as desirable spots, but there were no takers. No one suggested taking this task on.

Mr. MACDONALD. They did not volunteer themselves?

Dr. WEXLER. No.

Mr. MACDONALD. There was some suggestion for an icebreaker for that purpose in the Bellinghausen Sea, which I understand is unclaimed territory.

Dr. WEXLER. The icebreaker in operation in the Ross Sea was supposed to have made some traverses in this area. Whether they succeeded in penetrating to the coast, I have not heard.

In addition to these seven coastal stations, the recommendations were made for another interior station at 80 degrees south and 80 degrees west and then four more stations in the interior of east Antarctica.

There were no takers for those stations either. These were considered to be desirable just to fill up the tremendous gaps in Antarctica.

Dr. GOULD. Anyone who says the Russians are not dreamers should listen to what has been said. The U. S. S. R. has established a significant set of stations in Antarctica and reports of their work are that it is excellent. The Soviets have not yet been able to achieve one of their primary objectives of establishing a station at the geographic center of the continent which would be 400 miles from the South Pole on the 90th meridian, but they have approached this region and may be able to get to the Pole of inaccessibility during the next 12 months.

Dr. WEXLER. Now, if I may proceed, in view of the international meeting which took place barely 6 weeks ago and in view of the fact that the Academy had not set up the new Committee on Polar Research under Dr. Gould's chairmanship until the last few months, we have been vigorously trying to draw up a scientific program for Antarctica research after IGY.

Our thinking goes along these lines: that we should have full-fledged programs at the Pole Station and at the Byrd Station.

The Pole Station, as you all know, is located at the geographic South Pole. We have had this very important station and then the station in the center of Marie Byrd Land. Also, we would like to see the Little America Weather Station but because of the possibility that Little America will go out with the ice one of these days, as it eventually must, it was decided not to keep the other scientific programs at Little America, just keep Weather and move it to Kiel Field, which, as you know, is located a few miles farther away from the ocean, and to move the scientific equipment out of Little America. It was once thought that that scientific equipment would be moved to McMurdo Sound, which is the Navy's air facility where you landed and took off.

The CHAIRMAN. As a matter of fact, we recommended that.

Dr. WEXLER. Yes, sir. However, in the last month or two, New Zealand has made up its mind to keep their Scott base going after

IGY. They were uncertain about this at the time we went through New Zealand, but they have definitely made up their mind to stay in with the possible assistance of a few United States scientists to help them out in areas where they are short of trained personnel, which means therefore that it is not necessary to set up another station just a few miles away. The recommendation that the Committee on Polar Research of the Academy is making, therefore, is to move the Little America equipment to a new camp at the foot of the Beardmore Glacier where you know there has been an emergency airfield and weather station for flights to and from the pole and for smaller planes to gas up as they return from the pole.

The CHAIRMAN. It is at the foot of Beardmore Glacier?

Dr. WEXLER. Yes.

The CHAIRMAN. Really?

Dr. WEXLER. You flew right over that.

The CHAIRMAN. It is about 200 miles in.

Dr. WEXLER. About 400 miles from McMurdo.

Our recommendation would be to build that up to be a second Little America, that is, a full scientific program with the exception of a weather central. This would offer great advantages in investigating glaciology and geology of the very interesting area that Dr. Gould looked at many years ago when he followed his dogs into that area.

The CHAIRMAN. You recommend a Pole Station, the one in Marie Byrd Land?

Dr. WEXLER. Yes, sir, continuation of those.

The CHAIRMAN. And moving Little America in at the foot of Beardmore Glacier?

Dr. WEXLER. Yes.

The CHAIRMAN. That is three.

Dr. WEXLER. Then Hallett Station would continue as it has during the IGY in collaboration with New Zealand. They have definitely made up their mind they would like to continue that program.

We need Hallett Station anyway as an emergency landing strip and weather station for flights to and from New Zealand to McMurdo. So that station would continue.

The CHAIRMAN. How far would the Little America Station, should it be moved to this place, be from what we saw as the outpost of Liv. Would it be in that area?

Dr. GOULD. Yes; the confusion arose when they first established the station. They mistook Liv Glacier for Beardmore. They established the station at the foot of Liv Glacier and called it the Beardmore Station.

Dr. WEXLER. They decided to move it at the foot of Beardmore and call it the Liv.

From now on we propose to call it the Beardmore, and it is at the foot of Beardmore. Crary blazed the trail from Little America to Beardmore over which Little America scientific equipment would be transplanted to the foot of Beardmore, passing very close to McMurdo Sound as you go along the edge of the ice shelf west almost to McMurdo and then south to the Beardmore.

Mr. HALE. Will that Beardmore station be on land or be on shelf ice?

Dr. WEXLER. On shelf ice, at the foot of the glacier.

Then that leaves two stations that we have maintained during the IGY—the Wilkes Station and the Ellsworth Station.

The CHAIRMAN. Do I understand that this is the recommendation of the Academy?

Dr. WEXLER. Of our committee.

The CHAIRMAN. Yes, of the committee.

Dr. WEXLER. To the United States Government. With regard to these other two stations we have recommended continuance of the scientific program at the Wilkes Station on the Knox coast and at the Ellsworth Station on the Weddell Sea, continuance possibly in collaboration with Australia in the case of the Wilkes Station and Argentina, United Kingdom, or Chile, or all three if they wish to come in, for the Ellsworth Station on the Weddell Sea.

The CHAIRMAN. Do you know what the recommendation has been for which funds have been requested? Has that been made public, Doctor?

Dr. ODISHAW. The program that the Committee on Polar Research has recommended is before you, and in accordance with your wishes this document was released to the press, too. That program includes these recommendations of the committee for these stations, including the points about Ellsworth and Wilkes where the committee's position is that scientific programs should be continued at those stations—if possible, of course, in collaboration and cooperation with the nations that Dr. Wexler mentioned, for reasons of economy. But, if not, the committee's position is that they should be continued by the United States.

The CHAIRMAN. In the recommendation to us on the budget, are there funds provided for these two stations to continue either with or without the cooperation?

Dr. ODISHAW. The Committee on Polar Research is working on the budgetary aspects which will include some funds for these two stations and this document will be submitted to the Government, the National Science Foundation specifically, in the near future in a final form as this work progresses. But there are, of course, logistics problems in terms of what logistics one might be able to secure from the Department of Defense.

This picture is not clear in our own minds. We do not quite know what the situation is on logistics for it.

The CHAIRMAN. That was going to be my next question.

Dr. GOULD. The question about logistics refers only to Wilkes and Ellsworth. The other is all assured, as you know, Mr. Chairman.

Dr. WEXLER. With the possible exception of the Beardmore, the question of obtaining buildings, etc., for the Beardmore would have to be studied by Task Force No. 43.

The CHAIRMAN. What arrangement, if any, or what decision has been made as a substitute for the McMurdo ice runway?

Dr. WEXLER. I guess they are hoping this will just freeze over.

Dr. GOULD. That is a $64 question, Mr. Chairman, and it will call for sharp decision until Admiral Dufek is back.

If the bay ice does not freeze awfully thick this winter, our problem is going to be a very serious one. Presumably the bay ice will get thick enough so that the Globemasters can fly in very early, but it will mean that the flight season for supplying material by air drop

to the Pole and Byrd Stations must be carried out in October and November. It should be quite safe then but it reemphasizes again your own observations, Mr. Chairman, and those of your committee when you were there, that if we are looking toward continuity in Antarctic work, we must face up to the high desirability of an airstrip built on the rocks.

Mr. MACDONALD. Has anything more been done at Cape Bernacchi?

Dr. GOULD. I looked at it last year, as you may know. This year, Father Linehan, the seismologist whom you met, did go over and made a survey demonstrating that it is a feasible place to build an airstrip. The geology is all right and the glacier that is nearby has not moved in the last 50 years. There is little chance that anything would disrupt it and it seems as though it would be relatively snow free the whole year around.

The only question involved, Mr. Macdonald, is the cost.

Mr. FLYNT. Is anyone prepared to make an estimate at this time?

Dr. GOULD. I do not believe anyone could do more than pull a figure like two or three hundred million dollars out of a hat. It would be very expensive but if we are going to stay there a long time it is a highly desirable place not only for the airstrip but, of course, a more desirable place for a permanent camp than any other place we have.

The CHAIRMAN. Dr. Gould, we have made some recommendations to the President, the State Department and to the National Security Office with reference to claims. We know that is a very sensitive issue but it is a very important one.

I am sure that you are not advised as to what, if anything, has been done.

I wonder if you would agree with me that it would be better to settle that particular problem or at least decide what policy is going to be pursued before such an undertaking is made.

Dr. GOULD. I agree with you heartily, Mr. Chairman. As you may know, the whole situation on Antarctic claims has changed since we last talked about it as a result of the observation of the United Kingdom that they believed some kind of internationalization was the solution and the Prime Minister of New Zealand said New Zealand would go along with Great Britain. Some observation was quoted in the New York Times. He made the observation he did not see how the matter of future operations in Antarctica could be resolved except on some kind of international basis.

I agree with you, we must know what the future holds in store for us before we invest two or three hundred million dollars in the runway, important as it may be, not only for the scientific program continuing in Antarctica but, as you people have learned, from the whole broad aspect of trans-Antarctic flights, there ought to be one landing field there at least.

If there were such a landing strip at McMurdo Sound now there would not be any problem in trans-Antarctic flights.

The CHAIRMAN. Has there been any determination here as to what organization would head this scientific work beyond 1958?

Dr. GOULD. We are just in the process of discussing that now. As you know from your own observations, the arrangement we had at the National Academy of Sciences, the National Science Foundation, and

Task Force 43 worked it out superbly, but the kind of program we are thinking of will carry on for 5 to 10 years, I hope, and when we think in terms of that length of time perhaps some new kind of organization will be necessary.

I do not know, Mr. Chairman, but you raised your question in your letter to Mr. Bronk as to whether a non-Government agency should continue this relationship in a long-term program as it has in the temporary IGY program.

I talked this morning with Dr. Waterman about it. I have not been able to talk with Dr. Bronk about it. He has been ill. He has been hospitalized for some time, not seriously, but there has not been time to explore this as thoroughly as we should. But there is less urgency about that than some other aspects of the case, but it is something that will have to be resolved in the predictable future.

The CHAIRMAN. Of course, we are considering appropriations now for the next fiscal year.

Has the National Science Foundation asked for funds to continue?

Dr. GOULD. Yes; the National Science Foundation has been directed to go ahead and ask for funds to continue the program. Then the details of organization, if it be different from the present operation, are still to be resolved.

The CHAIRMAN. Probably I should ask Dr. Cornell or Dr. Joyce if the National Science Foundation has requested funds for this purpose.

Dr. JOYCE. Mr. Chairman, the Foundation has not formally requested funds for this purpose as yet. We have indicated our willingness to seek a single appropriation for the scientific program in the Antarctic, and we are now negotiating with the various other agencies within the executive that are concerned with this problem, hoping that they will agree with this procedure. These negotiations are now underway and have not been completed.

The CHAIRMAN. We are in the midterm, you might say, of this session of Congress. Next week the Easter recess will get underway. We will be out for a week or 10 days and be back here about the middle of April.

I would like to remind you that time passes pretty fast around here. After that it leads us into the end of the session. Things get into a pretty crowded program around here. I think something is going to have to be decided on right away.

I would regret very much, and I believe my colleagues here would share this view with me, I would regret very much to see a slip-up of this program at this time. I think it is important. It is too important to our future existence. If we are going to be derelict in doing what we ought to do and let some other country step in and take over important work that we have started, then I think it would be a terrible situation. I certainly do not want to see that happen.

Dr. JOYCE. Mr. Chairman, I can assure you that we are moving as rapidly as we can. It is our firm intention, once we get the concurrence of the agencies, to put in a request for a supplemental appropriation.

Mr. HALE. Mr. Chairman, I would like to inquire of any or all of these gentlemen whether they think that international status is consistent with the requirements of the capital investment necessary for carrying on any appropriate program.

The CHAIRMAN. Did you get Mr. Hale's question?

Dr. GOULD. I am afraid I heard it. It would have been better if I had not, because I have not any answer. I do not know, Mr. Hale.

Mr. HALE. I talked to a representative of the State Department about 3 weeks ago. I pointed out that I thought I could see everything that could be said for the internationalized status. I also envisaged what you talk about, the necessity of a very large capital investment certainly at Cape Bernacchi, and probably elsewhere ultimately, probably several other places on the continent, and who is going to make it if it is just an internationalized area. I would like to get an answer to that.

Dr. GOULD. That gets entirely out of the realm of our scientific responsibility.

Mr. HALE. I appreciate it is not a scientific question, but it is a very important question.

Dr. GOULD. It is important, of course. We have invested billions of dollars elsewhere in the world without the probability of securing such good returns as we should from the scientific program in Antarctica. But it would not be well even for us to have any recommendation, I think, as to what could or should be done there, Mr. Hale.

Mr. HALE. If you had a bill in here, not even an appropriation bill, but if you were to seek an authorization for an airport at Cape Bernacchi, I am sure that the first question that a congressional committee would ask would be: What is the title; what assurance would there be that our investment would be protected? and so on.

Dr. GOULD. Such recommendations, of course, would come to Congress from the Department of Defense, from the agency responsible for logistics; I mean, if we continue the present thinking we have had no responsibility outside of the National Academy of Sciences for the logistics. We prepare the scientific program. They assume the responsibility for the necessary logistics. What their answer would be to that, I would not even hazard a guess.

Mr. FLYNT. It occurs to me, in addition to that, some recommendation would have to come from the State Department giving an announcement of future policy on this question of territorial rights.

Dr. GOULD. It seems to me that that would be fundamental and necessary, Mr. Flynt.

The CHAIRMAN. May I inquire if you have any suggestions with reference to legislation that might be needed to effect the program that you have outlined?

Dr. GOULD. I do not know that any legislation is necessary for the program immediately ahead of us. Am I not correct, Dr. Joyce?

Dr. JOYCE. I believe that the authority of the Department of Interior to operate in that region is necessary if geological work is to be done. It is my understanding that legislation to take care of this is now in process. I know of no details, however, concerning it. Other than that, I think we are in the clear.

Mr. MACDONALD. Why the Department of Interior? Where does their jurisdiction affect the work going on in the Antarctic if no territorial claims have been made, which obviously they have not?

Dr. JOYCE. If I may go off the record.

(Discussion off the record.)

The CHAIRMAN. What I have reference to is, do you think that present law would permit the Weather Bureau to perform its immediate function anywhere in the world?

Dr. WEXLER. We have so far been able to do this in United States possessions and in the Arctic. The Arctic is mentioned specifically in our legislation. I believe action has been started to include the word "Antarctic" in close conjunction with the Arctic to permit us to operate in the Antarctic after the close of the IGY in the same way as we have done in the Arctic. I am sorry that I do not know the exact status of that inclusion with respect to the Antarctic.

Mr. FLYNT. Dr. Gould, I have another question. I would like the question to be on the record. I will leave it to you and your colleagues as to whether your answer should be on or off the record. With regard to the possibility of furthering the scientific studies already in progress which would be most beneficial to the United States, a condominium status or international status?

Dr. GOULD. I have long thought that a condominium status, a joint claim with New Zealand and the United States and perhaps with Australia, would perhaps be the happiest kind of solution. We have operated essentially within that framework, and we have done it very happily. We have drawn upon the resources of New Zealand. We need it as our base and, of course, the operation of Halley Station has been one of the most successful in Antarctica. We know it would work, Mr. Flynt.

Mr. FLYNT. Dr. Gould, I thank you very much for that. I would like to say that I am in full accord with what you have just said.

Dr. GOULD. I recently had published a booklet by the Foreign Policy Association, headline series, called Antarctica and World Affairs, and I made the same recommendation in there.

The CHAIRMAN. I know it is a little bit out of the realm of your activity, with the exception of the necessity of it; you must have logistics supplied, obviously, by the military. Have you any information as to what is being done with reference to larger and more powerful icebreakers?

Dr. GOULD. I have no idea at all whether any have been commissioned or designed or thought of.

Mr. MACDONALD. Currently there is before the House Merchant Marine and Fisheries Committee a bill to supply an atomic icebreaker, but I have seen no recommendations from the Department of Defense or National Science Foundation as to whether or not it would be welcomed by the scientists in Antarctica.

Would you like to comment on that?

Dr. WEXLER. This opens up a very interesting subject of Antarctic oceanography.

The task force, in sending icebreakers and ships to the Antarctic has done this from a point of view of penetrating through the ice and unloading men and equipment. They have taken science measurements in oceanography from these ships as opportunity permits in view of their very tight schedule, but not as much, really, as the problems require. This is because, as I say, the ships are mostly operationally guided. Our Committee has considered this situation very carefully and is coming out with a very strong recommendation to the Government that at least two ships be specifically designated as

oceanographic research vessels, a powerful icebreaker to penetrate through the ice, and another type ship, which need not necessarily be an icebreaker, to study Antarctica oceanography away from the ice.

We consider this to be particularly important in view of the international agreement made at the Hague meeting which called for a coordinated international attack. We hope to send our resolution very soon to the Government, asking that these ships be made available and not have any operational duties which might interfere with the scientific mission.

I might add in that connection that the Soviet ships, once they have unloaded their cargo, are completely free for scientific work. They do not have to do any further operations. As a result, in the past few years the Soviet icebreakers in the Antarctic have taken perhaps more oceanographic observations than the rest of the nations combined.

The CHAIRMAN. That certainly is interesting information. We certainly would be interested in the progress that you are able to make with your recommendation.

Mr. O'HARA. Do we not have any icebreaking operations up there or icebreaker ships at all?

Dr. WEXLER. We have had four icebreakers in the Antaractic. Three of them were on the Ross Sea side where Little America is and the other is on the other side, the Weddell Sea side, to pave the way for the Ellsworth supply.

These ships have been extremely busy. They are primarily there to take care of the operational aspects, the unloading of cargo and men. They have had little opportunity to do as much scientific research as oceanographers would like to have done in that area. They have done a fair amount of work and it is to their credit they have been able to do that much taking into account their tight operations.

Dr. ODISHAW. One should bear in mind with respect to the reference to the Soviet ship, that it is in fact a floating oceanographic laboratory. Half of the ship or some such portion is devoted to laboratory facilities. This accounts for their ability to do extensive oceanographic work in that region as well as in other regions.

We do not have a comparable ship that is a floating laboratory and that can operate in the Antarctic waters.

Mr. O'HARA. To what extent do they give us any scientific data?

Dr. ODISHAW. Their information will be available to us within the IGY program. As this new international program after the IGY develops, the arrangements will be similar; that is, the data will be made available. As a matter of fact, perhaps Dr. Wexler wants to expand on this. In oceanography the international plan calls for really studying the waters near the continent, all around the continent, and there are some very interesting scientific problems that Dr. Wexler is very familiar with.

Dr. WEXLER. A month ago in New Zealand, at the original suggestion of Dr. Gould, when he passed through there a year ago, there was held a New Zealand Antarctic Symposium. All the members from the 6 or 7 countries that were able to come to New Zealand had a very interesting symposium. The Russians sent their ship, the *Ob*, to Wellington. It was thrown open to inspection. The people who attended that meeting reported very favorably on the laboratory

facilities on the ship. They were also shown the oceanographic observations which had been taken during the past season and also previous years. There was no restriction on their looking over all the laboratory facilities and all the data they had taken.

We would expect that very soon those data will be distributed in the usual scientific publications.

Mr. DEROUNIAN. May I ask why the Russians up to now have been unwilling to give us some of their data on Sputnik I and II? Was it not at some meeting recently that they were derided for just giving general information which was public knowledge in the newspapers but they had not given any scientific information to the world?

Dr. GOULD. Maybe Hugh Odishaw can comment on that but I suspect the material is not processed and readily available yet. It is too early to say that they are not going to give us all of the information from sputnik. I remember talking with Roberts of our own Climax Observatory in Colorado. He said they had collected enough information about Sputnik No. I to take them 2 years to interpret it. That may be part of the answer.

Dr. ODISHAW. I would like to confirm that. It is well to bear in mind there are two types of data that are important on an interchange basis so far as satellites are concerned.

There are agreements within the IGY covering both types.

The first type has to do merely with where is it, so that observers of other countries can track it or can pick up telemetry as the case maybe.

The second type has to do with internal experiments.

As to type 1, we have had notification from the U. S. S. R. on their launching within the time agreed to internationally.

I would say that the record there has been satisfactory and comparable to our own record.

As to the internal experiments, Dr. Gould's point is well taken. There is a serious problem in taking the telemetry data, reducing it, analyzing it, correcting it, and this takes a great deal of time.

In our own rocket program we have had very few reports as yet and have not been able to send any to the other world data centers as of the present time, simply because of the slowness of the process. How things will develop we do not know but we believe they will follow the IGY pattern.

The CHAIRMAN. Dr. Cornell, would you like to comment on the overall work of the International Geophysical Year, either you or Dr. Joyce?

Dr. CORNELL. Mr. Chairman, I represent the National Academy of Sciences. In the first place, I would like to say that reference has been made to Dr. Bronk having been incarcerated in the hospital in New York and he was sorry indeed not to be with you today.

The CHAIRMAN. We are sorry that he has been ill.

Dr. CORNELL. He has had a difficulty with his leg which is a minor thing medically but a major thing with regard to holding him down He told me on the phone this morning that he finally had persuaded the doctors to let him out in the next few days and he hopes to be back in his office at the Academy from time to time beginning this weekend but he could not be here today.

Dr. Gould earlier had reference to the situation in which the work with regard to the Antarctic has found itself a lot more advanced with respect to the planning of the post-IGY period than has the work in other areas. I thought it might be well to say a word about one or two other areas in which there has been at least a good beginning although the work has not advanced as far as has the consideration of the Antarctic problems.

One of these has just been referred to and that is oceanography. This, of course, is an extremely important part of the IGY, not only the oceanography of the Antarctic, which has been discussed, but oceanography generally.

Prior to IGY there had not been an extensive interchange of oceanography data even though what happens in any part of the oceans of the world depends a great deal on what happens in every other part of the oceans of the world. Whereas in astronomy and meteorology the international exchange of data has been excellent except in time of actual war, that has not been true in the field of oceanography.

The IGY for the first time has established a worldwide network of exchange of information on oceanographic measurement. At the same time the International Council of Scientific Unions, which, as you know, is the father of the IGY and is the great nongovernmental international body for scientific cooperation, has recently established a special committee for oceanic research which is an international committee. Its chairman is Dr. Roger Revelle of the Scripps Institution in California.

The National Academy of Sciences, at approximately the same time, appointed a committee on oceanography under the chairmanship of Dr. Harrison Brown of the California Institute of Technology to give thought to the general health of oceanography and its development as a science in this country, and to effect participation on behalf of the scientists of the United States in the work of this Special International Committee on Oceanic Research.

Our committee is hard at work and will serve as the United States National Committee for this Special Committee on Oceanic Research. It will also advise the Government through the Department of State and other agencies, on the international oceanographic work of, for example, the Pan American Institute of Geography and History, and other international governmental organizations.

Our committee is not connected with the IGY as such, but will, as a part of its considerations, have the whole development of oceanography in this country, including the post-IGY era, as a part of its area of interest.

This is another example of the international cooperation that the IGY has very much stimulated in an extremely important area of science in which the United States has much to gain by cooperation with the other nations of the world.

Another area that has been of considerable interest is that of meteorology. Meteorological measurementss are an important part of the International Geophysical Year.

Two years ago the Academy established a Committee on Meteorology under the chairmanship of Dr. Lloyd Berkner, of New York, to consider the whole development of meteorology as a science in this

country, including its relationship to oceanography which is a matter of very great scientific importance.

That Committee produced a couple of months ago its initial report on the development of meteorology in this country.

This Committee will continue in existence and will give consideration to our international responsibilities and opportunities and to the continuation of the impetus provided in the field of meteorology by the work of the International Geophysical Year.

Meteorology and oceanography are two particular areas of science. Our Polar Committee, on the other hand, represents a geographical area where the Academy has taken steps to insure the continued effectiveness of what has been started by the IGY. A similar area of particular interest is that of space.

The Academy is in the process of appointing a Committee on Space Science. Dr. Bronk has discussed this with a number of possible appointees to that Committee and, of course, with a number of governmental people. It is very important to us to see in which direction the Government will move in its organization relating to the development of space science.

This is another geographical area, so to speak, rather than a field of science, and will be important to many fields of science; for example, to cosmic rays, to rocketry development, to biological and medical questions, psychological questions, and so on.

The Academy Committee will include representation from these various disciplines of science and will, I am sure, be closely related to the Government's efforts in that area.

I shall be glad to expand on any point, if you like, Mr. Chairman.

The CHAIRMAN. Thank you very much, Dr. Cornell.

I personally appreciate that description which you have given of this activity of the IGY.

Are you satisfied and are all those associated with you satisfied that there is the mutual cooperation between all the nations participating in the program?

Dr. CORNELL. We have had every reason thus far to be wholly satisfied and greatly encouraged by the degree of international cooperation that has been evidenced in the International Geophysical Year. I think it is a great new step in scientific cooperation.

I also think, Mr. Chairman, that within this country the arrangement by which the Academy as a nongovernmental organization, with access to the entire scientific community, has carried the burden of leadership in the scientific planning of the IGY and has found the closest cooperation with many agencies of the Federal Government through the National Science Foundation, has been a new and heartening example of cooperation between Government and nongovernment interests which is necessary in these expanding areas of science with their increasing costs and increasingly close relationships to the national interest.

Mr. O'HARA. Might I ask a question, Mr. Chairman?

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. I wonder in this space situation if any thought has been given to the legal claims of the respective nations as to the space over and above that nation. I mean you try to fly over Russian territory and see what happens to you, for example. What is going to be

their attitude when we get into this space situation? Are they going to claim a part of the atmosphere above Russia or what? What will the situation be?

Dr. CORNELL. In answer to that, sir, I do know that consideration has been given to that but I know none of the details. This is outside of the scientific area. As far as I know in the IGY no question of this sort has been raised. In the same way the United States raised no hue and cry, except in some of the newspapers perhaps, over the overflying of this country of the sputniks. We have every reason to feel that if a United States satellite overflew Soviet territory we probably would not have any reaction from them.

As to the future when instrumentation of satellites is better developed, I have no idea.

The CHAIRMAN. Do you anticipate it will be some years, a year, 2 or 3 or longer, before that time, Doctor?

Dr. CORNELL. I think I am really not qualified to predict, Mr. Chairman. In these days of development, I hesitate to predict that it would be much longer than that. Maybe Mr. Odishaw would have further comments on that.

Dr. ODISHAW. I am not sure I understand the question.

Dr. CORNELL. Whether there might be instrumentation in the near future which would cause international repercussions in the overflying of other people's territory.

Dr. ODISHAW. I cannot answer that question. I do not know.

The CHAIRMAN. The interesting thing about it is that whatever might happen will happen before we have reached the point of obtaining the information that we should have to make a determination of what the future holds.

Mr. O'HARA. It certainly will be a question of what the nations are going to have to meet one of these days and get a sort of definite international agreement of some kind.

Dr. GOULD. Very little has been said of the international implications of sputniks and satellites but it is not a great jump to suppose that they will photograph anything they fly over.

Mr. WOLVERTON. In my endeavor to find a meeting place of this committee I got into a meeting of the joint committee that was discussing these various things that we are discussing.

Mr. O'HARA. With two guards at the door.

The CHAIRMAN. Dr. Odishaw.

Dr. ODISHAW. A remark that Dr. Cornell made in response to a question reminded me of the topic with respect to the Soviet attitude when our satellites have a higher inclination and actually pass over the U. S. S. R. At the rocket and satellite conference in Washington last October, Soviet scientists expressed sorrow that the plans for United States satellite would not be observable over the U. S. S. R. As a matter of fact, I think they thought that we had planned it that way and we had to explain to them the limitations, geographic limitations of the firing point and the safety range considerations. At that time, at any rate, they expressed great interest in having United States satellites that they could observe.

The CHAIRMAN. In view of what Mr. Wolverton said a moment ago, perhaps it would be advisable to transmit and make available a copy of this record to the outer space people.

Dr. ODISHAW. I might add that the United States National Committee has been thinking about the experimental satellites, experimental satellites in the future beyond the IGY period. The satellite panel prepared such a report and the United States National Committee has reviewed it and endorsed it and has transmitted it to the President of the Academy and Director of the National Science Foundation.

This report will be published in the April 11 issue of Science, the weekly publication of the American Association for the Advancement of Science.

The press reported on this a few days ago. Some enterprising newspaperman got a copy from some source and a rather good summary in terms of its coverage appeared in the New York Times, and I believe some other papers also then got copies of this thing from our office and reported on it.

I do have some copies of that report, if the members are interested in reading about these experiments.

Yesterday, one of the Senate committees that has been set up on this subject, inquired about this report, and indicated at least tentatively over the telephone that they would like copies. Copies were sent to that Senate committee. They indicated that perhaps they would publish it in their hearings.

The CHAIRMAN. We would like to have some copies of that, Doctor, if they are available.

Mr. MACDONALD. Dr. Cornell, before we leave the subject of oceonography, am I correct in my understanding of both you and Dr. Wexler that the Russians have the single ship that is both an icebreaker and a floating laboratory?

Dr. GOULD. A magnificent one.

Dr. WEXLER. At least two, Mr. Macdonald. The *Ob* and the *Lena*. Now they have this atomic icebreaker launched a few months ago. I do not know if it is operational but there may be more icebreakers.

Dr. GOULD. There are few areas of science in which we have lagged further behind than oceanography.

Mr. MACDONALD. But it is a combined icebreaker plus a floating laboratory?

Dr. WEXLER. Also a cargo carrying vessel. The *Ob* and *Lena* went down to the Antarctic a few years ago. Then they pulled into an Australian port and took back 6,000 tons of grain to Hamburg, Germany, which helped pay part of their expenses.

Mr. MACDONALD. Are these atomic powered?

Dr. WEXLER. No, sir; these are ordinary diesels or motorships.

Mr. MACDONALD. How large are they?

Dr. WEXLER. I think of the order of 10,000 tons.

Mr. MACDONALD. Would the Coast Guard have jurisdiction in this matter, or would it be the Navy?

Dr. WEXLER. Both: the Coast Guard and Navy both have icebreakers. The Navy has the most of them.

Mr. MACDONALD. Does the Coast Guard have any oceanographic ships?

Dr. GOULD. The Hydrographic Office of the Navy, I believe, does.

Mr. MACDONALD. The Coast Guard does not have?

Dr. WEXLER. They do for ice conditions in the North Atlantic shipping lanes. They work very intensively in this area.

Dr. CORNELL. One of the subjects, Mr. Macdonald, that the Academy's Committee on Oceanography is considering at the present time is the very serious problem of the very costly facilities that are badly needed in this country for oceanographic research, whether they be governmental or private, they do not exist today in the elaborateness and size that are needed.

Dr. WEXLER. Speaking of oceanography brings up a matter of another ocean that you may want to have a brief discussion about; namely, the Arctic Ocean.

The CHAIRMAN. Yes; I wanted to ask something about the Arctic. I realize full well we are going along here. I think most of us, not all, have to be down on the floor pretty soon and I did want to have some comment from you about it before we concluded.

Dr. WEXLER. This will be very brief, Mr. Chairman. Perforce, our committee has spent most of its time in the three meetings we have had on the Antarctic because of the very long lead time to get men and equipment down there for the next season, but we have studied the Arctic and we are in the process of formulating our recommendations.

As you know, our program in the Arctic was a fairly substantial one even before the IGY, particularly when it came to land stations. We had our scientific stations in Alaska, Point Barrow, College, Alaska, outside of Fairbanks, and then in cooperation with the Canadians we have had a half dozen joint weather stations in the Canadian Archipelago as far north as 82 degrees latitude and, of course, Thule, Greenland, has been a scientific station in addition to a military base.

During the IGY, two additional stations have been set up on the ice in the Arctic Basin; namely, on Fletcher's Ice Island, which is ice very similar to the Ross Ice Shelf that projects above the surface some 30 or 40 feet.

Mr. HALE. Where is that?

Dr. WEXLER. I have a map here. Fletcher's Ice Island is this blue point here at approximately 80 degrees north and 115 degrees west. This has been occupied off and on since 1950. The latest occupation is during the IGY.

In addition, we had another station called United States Station Alpha on the ice pack itself at 82 north and 155 west. Both of these stations were set up for IGY and it is our recommendation, speaking for the Committee on Polar Research, that scientific programs be continued on those two stations in regard to meteorology, oceanography, the ice and whether it is increasing or decreasing, and also the ocean floor, the topography of the ocean and the submarine geology of that area.

In your committee report, on page 38, I believe you reproduced the map given out by the Soviets showing the landings they have made on the ice with their planes at several hundred points.

The CHAIRMAN. I wish to call that to the attention of every member of this committee. If you have not seen it, I think it is one of the most interesting things that I have had brought to my attention.

Dr. WEXLER. We have some reason to believe, Mr. Chairman, that there may be more points than are indicated on that map. This has been going on since 1937 so far as the Soviet endeavors are concerned.

We feel in this country that we should accelerate our scientific investigations in that area, even to establishing more than two stations.

As I mentioned earlier we are in the process of coming out with a scientific proposal but certainly it will call for at least the maintenance of the two IGY stations.

The CHAIRMAN. Do you think that is sufficient in the Arctic? Of course, you have one on the coast of Alaska, northern Alaska?

Dr. WEXLER. Point Barrow. It is really difficult for me to come out with any statement in answer to that question, Mr. Chairman, until we have made further study with regard to the IGY observations and plans of other countries.

The CHAIRMAN. Now we could really go on with this very interesting meeting but I think perhaps, unless there are some other questions, we had probably bring this to a close.

I would like to inquire of Dr. Cornell if we might anticipate a full reply to the letter of January 13 that I spoke of a moment ago to Dr. Bronk. As I understand, their National Research Council is meeting here in the next few days, about 250 members.

Dr. CORNELL. About 230 members.

The CHAIRMAN. Of course, you have said something about the field meeting but I understood this meeting may cover the whole area in the IGY.

Dr. CORNELL. A portion of this meeting will be devoted to the general question of what we call "Beyond the IGY." Out of that will come additional views and opinions from which I think Dr Bronk will be able to judge, with the help of the IGY organization, whether additional areas beyond those we have discussed today need specific coverage in the same way that these are being covered.

In answer to your question, I am sure that Dr. Bronk intends to give you a full reply when he can see his way through the various aspects of it.

The CHAIRMAN. Please extend to him our best wishes and hopes for a speedy recovery.

Dr. CORNELL. Thank you very much.

Mr. WOLVERTON. May I ask a question, Mr. Chairman?

The CHAIRMAN. Yes.

Mr. WOLVERTON. It is more or less of a personal nature.

(Discussion off the record.)

Mr. WOLVERTON. I was interested in something I saw on page 7 about viewing the satellite. What has intrigued me from the very beginning on this whole thing is how it is possible for the human eye, as I understood it was possible for the human eye, to see this Vanguard or whatnot that is in effect only a few inches in diameter at the great distance it is away. Am I wrong in the assumption that it can be seen by the human eye?

Dr. ODISHAW. The test sphere, that is the Vanguard satellite that was launched not too long ago as part of the test program, is not visible, it is too small. However, the empty rocket carrier of the last stage, which has a white coating, is visible and I have had reports that it has been seen. It, too, is in orbit. The last stage, when it fires and then separates, gets into orbit. That stage has been seen. Now, with the two satellites that have been fired, using modified Jupiter-C's by the Army, both of those are cylindrical in shape and they have

sufficient surface area, that both are visible. As a matter of fact, there is a photograph taken by one of our cameras in the Union of South Africa. But the smaller sphere, the test sphere which has become the satellite 1958 Beta, is too small.

Mr. WOLVERTON. That cylinder you speak of is a very small affair?

Dr. ODISHAW. It is. It has to be properly illuminated under twilight conditions when it is dark in the sky but not when the sun illuminates the satellite against the dark background.

Dr. CARROLL. It simply looks like a bright point. It looks like a star except that it is moving much faster than a star in the sky.

The CHAIRMAN. Gentlemen, let me thank you very much for your courtesy in coming out and visiting with us this afternoon and the information that you have conveyed to us. It is very helpful.

I know that you are tremendously interested and concerned in your work. On behalf of the committee, let me compliment you on the magnificent job that you are doing and the very fine work you are doing which our Government will receive the benefit of as well as other nations of the world.

You are to be commended for your efforts in this field. Even though we cannot understand all the scientific terms and knowledge and so forth we do want you to know that we are interested and we want to be helpful in any way we can be.

We certainly stand ready to be subject to your call. When we do have the information referred to, Dr. Cornell, we may later on want to talk to you further about it.

Dr. CORNELL. Yes, of course.

Dr. GOULD. We shall be glad to join you again, Mr. Chairman.

The CHAIRMAN. We shall be glad to have you all back with us.

Dr. Waterman, I suppose, will be with us on another occasion.

Dr. JOYCE. Yes, I am sure he will be glad to come.

(Whereupon, at 4:55 p. m., the meeting adjourned.)

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